Appendix I
Formed Suction Intake - Geometry Limitations

I-1. Purpose

This appendix provides guidance necessary to properly select the best, most cost-effective formed suction intake (FSI) design.

I-2. Background

The U.S. Army Engineer Waterways Experiment Station (WES) conducted research to determine by how much the height of the FSI could be reduced without adversely affecting its performance. ETL 1110-2-327 presents, in detail, the results of the research. Results of prior research conducted at WES about the basic FSI design are presented in Technical Report HL-90-l. Formed Suction Intake Approach Appurtenance Geometry (Fletcher 1990). The 1990 report provided guidance for the design of FSI external appurtenance geometry (pump bay width and/or length) relative to the direction of approaching flow, discharge, and submergence. The type 1 design (Figure I-l) provided the optimum design at that time. The research presented here was initiated by requests from field personnel involved in pumping station design. The field wanted to know how to reduce the height of the type 1 FSI. Reducing the height of the FSI impacts favorably on the design of a pumping station. It raises the sump floor and reduces the elevation of the impeller. This in turn reduces excavation and increases the available static suction head on the pump impeller.

I-3. Test Results and Recommendations

Site-specific model tests conducted at WES demonstrated that changing one or more of the FSI's internal dimensions adversely affected the flow distribution inside the FSI. The minimum permissible height of an FSI was determined by conducting tests to evaluate independently and compositely the limiting values for the radius of the roof curve, the cone height, and the height of the roof curve above the floor of the FSI. The type 10 FSI (Figure I-2) represents the optimum design, i.e., a design with the minimum permissible height. By reducing the cone height from *0.45d* to 0.22d and the height of, the roof curve above the floor from *0.56d* to *0.49d,* the type 10 design changed the overall height of the type 1 design from *1.58d* to *1.28d.* This provided a 19-percent reduction in the overall height. Based on the test results, it is recommended that the height of the FSI not be less than *1.28d* and that the cone height and the height of the roof curve above the floor not be less than *0.22d* and *0.49d* respectively. The dimensions of the FSI are provided in terms of the throat diameter *d.* Various views of the FSI are shown in Figure 1-3. The isometric view shown in Figure I-3 clarifies the isometric view shown in ETL 1110-2-327. The ETL shows horizontal lines in the roof portion of the FSI. These were intended to be a drafting technique, not a method of construction. The roof should be constructed in a manner similar to that shown in Figure I-3.

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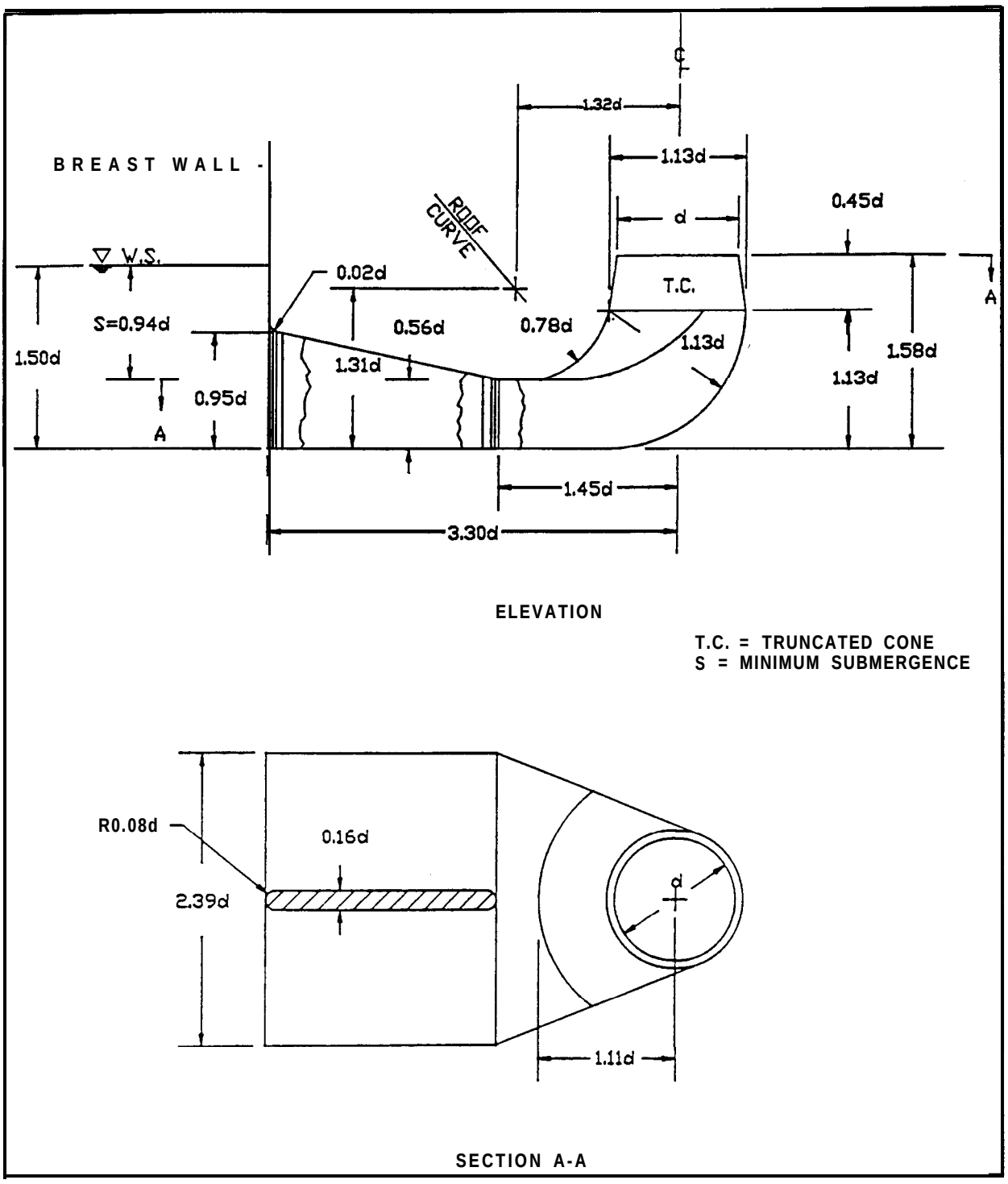


Figure I-1. FSI type 1 design

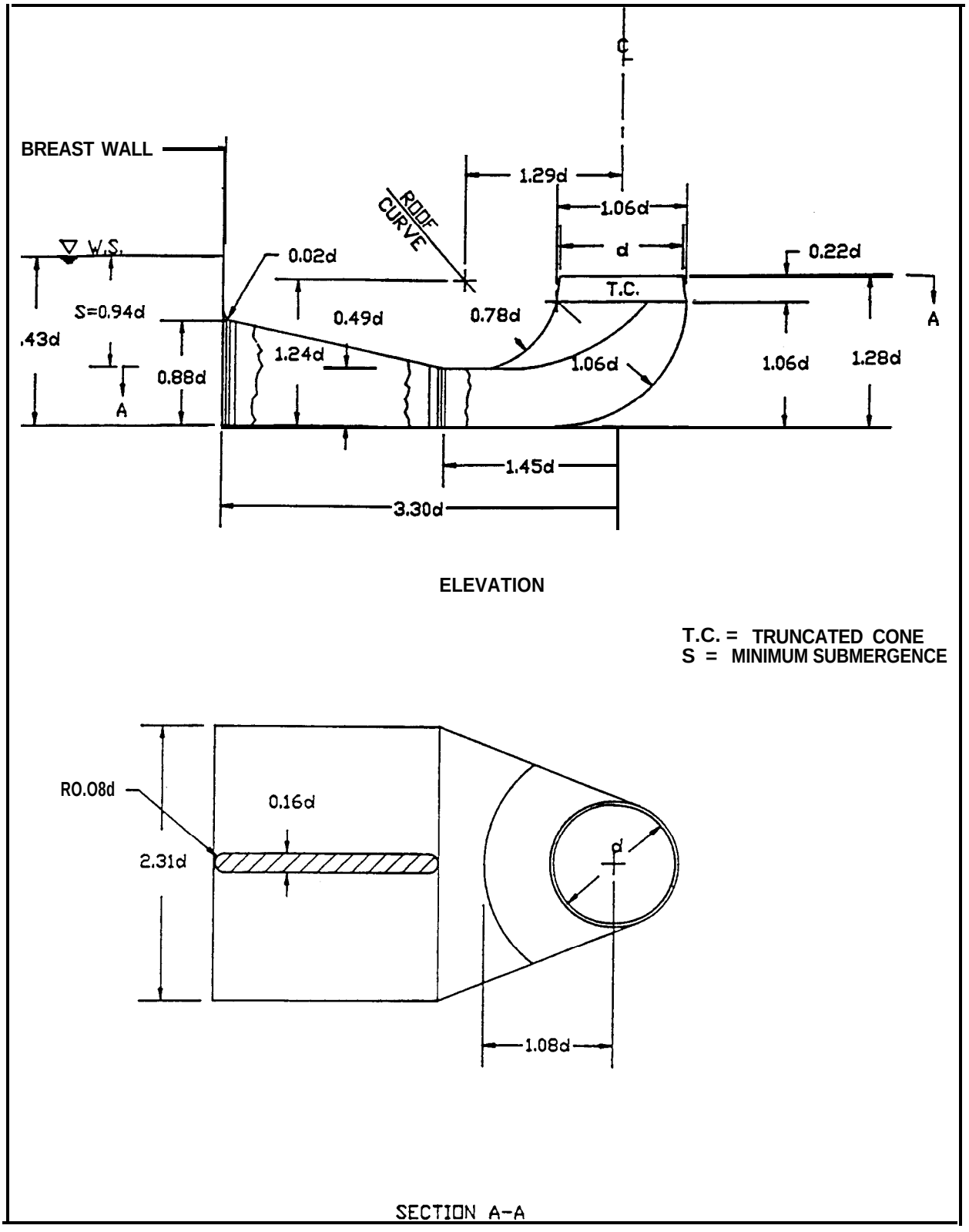
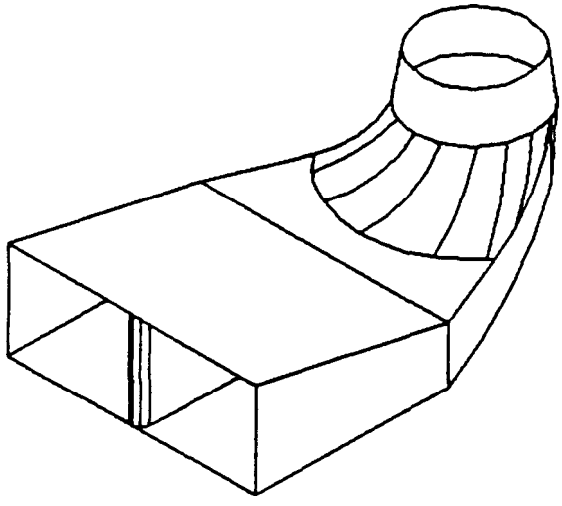
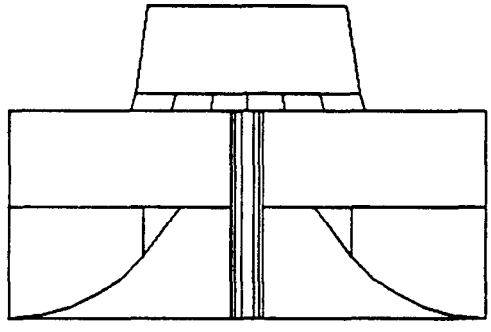


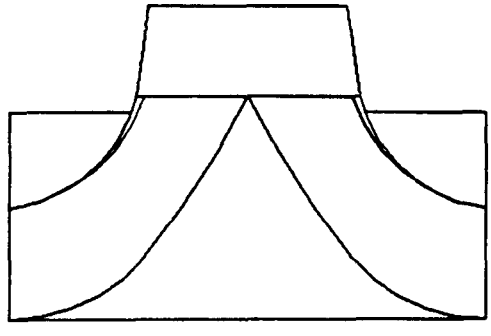
Figure I-2. FSI type 10 design



ISOMETRIC VIEW



FRONT VIEW



REAR VIEW

Figure I-3. Typical FSI